



# **In-Station Diagnostics Update**

November 14, 2006

California Air Resources Board

Cal-EPA



# Agenda

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- ISD Overview
- ARB ISD Status Reports
  - ISD Cost-Effectiveness
  - ISD In-Use Evaluation
  - ISD Advisory
- ISD Enforcement Policy
- District Experience with ISD Systems
- Veeder-Root Experience with ISD Systems
- Question and Answer



# In-Station Diagnostics (ISD) System Overview

- Identifies significant vapor recovery system failures automatically
- Notifies station operator
- Reduces emissions by early detection and prompt repair
- Supplements district inspections
- Concept similar to OBD for vehicles
- Tie-in to existing UST leak monitors



# ISD Enforcement Policy

## ■ ARB Policy

- ISD output not currently appropriate for enforcement
- No response by GDF operator to ISD failure signal is enforceable
- CAPCOA recommended enforcement policy issued June 27, 2006

# ISD Implementation

**> 1.8 million  
gallons/yr**

**New and Major  
Mod Sites:  
Sept. 2005**

**Existing Sites:  
Sept. 2009**

**600,000 – 1.8 million  
gallons/yr**

**New and Major  
Mod Sites:  
Sept. 2006**

**Existing Sites:  
Sept. 2010**

**$\leq$  600,000  
gallons/yr**

**Exempt  
From  
ISD**

# ISD Site Install Update

75+ ISD sites  
installed and  
operational

Over 100 ISD  
applications/permits  
pending

District	Pending Permits	No. ISD Sites
South Coast	88	36
Bay Area	13	10
San Joaquin	10	10
San Diego		9
Sacramento		4
Humboldt		3
Imperial		2
Santa Barbara		1
Ventura		1



# How ISD Works

Monitors Two Primary VRS Functions:

1. Collection of Vapors during Fueling
  - ISD flow monitor
2. Containment of Vapors in UST system
  - ISD pressure monitor
  - ISD leak test



# ISD Failure Modes & Assessment Frequency

	Degradation Failure	Gross Failure
A/L Ratio	Weekly	Daily
Balance vapor collection	---	Daily
UST Pressure	Monthly	Weekly
Pressure Integrity (leaks)	---	Weekly
Vapor Processor	---	Daily



# VR-202 ISD Alarm Thresholds

**Daily**  
1 day of data

**Weekly**  
7 days of data

**Monthly**  
30 days of data

	Degradation Failure	Gross Failure
A/L Ratio	$A/L \leq 0.81$ or $A/L \geq 1.32$	$A/L \leq 0.33$ or $A/L \geq 1.90$
UST Pressure	> 0.5 in WC > 25% of time	> 1.3 in WC > 5 % of time
Containment (leaks)	---	> 8 – 14 CFH leak @ 2 in WC

# Example ISD Daily Report

Got Gas?

1333 State Street

Sac. CA 96843

Nov 14, 2006 10:20 am

EVR Type: Vacuum Assist

ISD Version 01.00

Overall Status PASS

EVR Containment PASS

EVR Collection PASS

Stage 1 1 of 1 PASS

Self Test PASS

ISD Monitor Uptime 100%

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## Containment Tests

Gross 95% 0.1 "WC

Dgrd 75% -0.4N "WC

Vapor Leak 4 CFH

Max 0.5 "WC

Min -5.0 "WC

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## Collection Tests

Gross	Dgrd
-------	------

A/L(#)	A/L(#)
--------	--------

FP 1: Blend3

0.99 (46)	0.98 (305)
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FP 2: Blend3

1.09 (39)	1.13 (215)
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## Self Test

Setup Test PASS

Sensor Out Test PASS

# Blockage & Leakage Problem

MAY 17, 2006 1:03 PM

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Status Codes: (W)Warn (F)Fail (D)Degradation Fail (G)Gross Fail (ISD-W)ISD Self-Test Warning (ISD-F)ISD Self-Test Fail (N)No Test

		ISD	ISD	---CONTAINMENT TESTS---				STAGE			---COLLECTION TESTS-DAILY AVERAGE HOSE A/L RATIO-----											
		EVR	%UP	GROSS	DGRD	MAX	MIN	LEAK	I	VAPOR	FP1	FP2	FP3	FP4	FP5	FP6	FP7	FP8	FP9	FP10	FP11	FP12
		STATUS	TIME	95%	75%	"WC	"WC	CFH	XFR	PRCSR	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND
05/14	PASS	100%	0.2N	-0.0N	0.0	-0.8		N			0.92	0.68	0.81	0.89	0.76	0.90	0.81	0.90	1.02	0.94	0.00N	0.00N
05/15	W	100%	0.2	-0.0N	3.4	-1.0		175W	PASS		0.98	0.92	0.92	1.02	0.99	0.99	0.93	0.82	1.02	1.00	0.00N	0.00N
05/16	W	100%	0.1	-0.0N	5.0	-2.4		177W	PASS		1.01	0.83	0.92	0.93	0.86	0.96	0.80	0.86	0.86	0.83	BLKDW	BLKDW

LEAK  
CFH  
N  
175W  
177W

FP11 FP12  
BLEND BLEND  
0.00N 0.00N  
0.00N 0.00N  
BLKDW BLKDW

- Vapor leak was eventually tracked down to open ball valves on the Clean Air Separator, two nozzle leaks and three probe caps
- Blockage on FP11 & FP12 was determined to be the vacuum assist pump

# Leakage Problem

IV0700  
FEB 28, 2006 2:00 AM

...

DATE	ISD	ISD	---CONTAINMENT TESTS---				STAGE			---COLLECTION TESTS-DAILY AVERAGE HOSE A/L RATIO-----									
	EV	%UP	GROSS	DGRD	MAX	MIN	LEAK	I	VAPOR	FP1	FP2	FP3	FP4	FP5	FP6	FP7	FP8	FP9	FP10
	STATUS	TIME	95%	75%	"WC	"WC	CFH	XFR	PRCSR	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND
02/15	PASS	100%	0.5	0.0	0.4	-0.6	1			0.97	0.79N	0.87	0.88	1.04	0.96	0.97	0.95	1.00	0.9
02/16	PASS	100%	0.2	0.0	0.2	-0.4	5			0.98	0.79N	0.87	0.99	1.02	0.97	0.94	0.95	1.01	0.9
02/17	W	100%	0.2	0.0	0.3	-0.5	37W			0.90	0.98	0.93	0.96	1.05	0.94	0.94	0.95	0.98	1.0
02/18	W	100%	0.2	0.0	0.3	-1.1	34W	PASS		0.98	0.99	0.93	0.96	1.07	0.96	0.94	1.00	1.01	1.0
02/19	W	100%	0.2	0.0	0.2	-0.4	34W			0.98	0.97	0.90	0.98	1.02	0.98	0.94	0.97	1.02	1.0
02/20	W	100%	0.2	0.0	0.4	-2.0	34W	PASS		0.98	0.95	0.91	0.97	0.93	0.94	0.94	0.95	1.02	0.9
02/21	PASS	99%	0.2	0.0	5.0	-3.1	23N	PASS		0.98	0.96	0.91	0.97	0.96	0.94	0.97	0.96	1.02	0.9
02/22	PASS	100%	0.8	0.0	1.4	-0.3	7N			0.89	0.95	0.89	0.95	1.00	0.96	0.91	0.95	0.82	0.9
02/23	PASS	97%	1.0	0.0	1.3	-0.7	4N			0.94	0.96	0.91	0.99	0.90	0.99	0.92	0.93	0.97	1.0
02/24	PASS	100%	1.0	0.0	0.9	-0.2	5N			0.97	0.98	0.85	0.93	1.05	0.98	0.97	0.93	1.04	0.9
02/25	PASS	100%	1.0	0.0	0.5	-0.2	6N			0.96	1.02	0.90	0.93	1.00	0.99	0.95	0.95	1.02	0.9
02/26	PASS	100%	1.0	0.0	0.1	-5.0	4N	PASS		0.99	1.01	0.91	0.97	1.05	0.95	0.93	1.01	1.02	0.9
02/27	PASS	100%	1.0	0.0	0.4	-5.0	5	PASS		0.97	0.98	0.92	1.06	1.06	0.94	0.96	1.00	0.98	0.9

LEAK

CFH

1

5

37W

34W

34W

34W

23N

7N

4N

5N

6N

4N

5

traced to leak in vapor return piping

# Overpressure Problem

IV0700  
JAN 31, 2006 2:01 AM

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Status Codes: (W)Warn (F)Fatal
              (ISD-W)ISD Self-Test Warning
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	ISD	ISD	---CONTA									
	EVR	%UP	GROSS	D								
DATE	STATUS	TIME	95%									
01/10	PASS	100%	0.2	0		01/17	PASS	100%	3.9N	3.6N	4.2	2.6
01/11	PASS	100%	0.2	0		01/18	PASS	100%	3.9N	3.6N	4.2	-5.0
01/12	PASS	100%	0.2	0		01/19	PASS	100%	3.9N	3.6N	-0.0	-3.5
01/13	PASS	100%	0.2	0		01/20	PASS	100%	3.9N	3.6N	5.0	-0.2
01/14	PASS	100%	0.6	0		01/21	PASS	100%	3.8N	3.5N	3.9	2.5
01/15	W	100%	3.5W	0		01/22	W	100%	3.8W	3.5N	4.0	-5.0
01/16	PASS	100%	3.8N	3		01/23	W	100%	3.8W	3.5N	0.4	-2.2
01/17	PASS	100%	3.9N	3		01/24	W	100%	3.7W	3.4N	1.5	-0.3
01/18	PASS	100%	3.9N	3		01/25	W	100%	3.6W	3.4N	5.0	-0.0
01/19	PASS	100%	3.9N	3		01/26	W	100%	3.6W	3.4N	3.9	-5.0
01/20	PASS	100%	3.9N	3								
01/21	PASS	100%	3.8N	3								
01/22	W	100%	3.8W	3.5N	4.0	-5.0	0	FAIL	0.94	0.99	0.95	0.90
01/23	W	100%	3.8W	3.5N	0.4	-2.2	0N		0.98	1.03	0.94	1.02
01/24	W	100%	3.7W	3.4N	1.5	-0.3	0		0.94	1.01	0.87	1.00
01/25	W	100%	3.6W	3.4N	5.0	-0.0	0		0.98	0.95	0.92	0.98
01/26	W	100%	3.6W	3.4N	3.9	-5.0	0	PASS	0.96	0.93	0.94	1.05
01/27	PASS	100%	0.3N	0.1N	0.4	-0.6	0		0.93	0.97	0.91	1.07
01/28	PASS	100%	2.7N	2.3N	3.1	0.0	0		0.98	1.01	0.91	1.07
01/29	PASS	100%	3.6N	3.1N	4.1	2.3	0		0.97	0.95	0.90	1.07
01/30	PASS	100%	3.7N	3.3N	4.0	2.1	0		0.97	1.02	0.93	1.07N

## Problem traced to:

Low product flowrates  
(poor ORVR detection)

## Nozzle w/torn boot (poor ORVR detection)



# Plan to Update ISD Cost-Effectiveness





# Resolution 02-35

December 12, 2002 EVR Technology Review

*BE IT FURTHER RESOLVED that the Board directs the Executive Officer and Board staff to assess, following the initial certification of the first EVR Phase II system with in-station diagnostics (ISD), the capital cost impacts of ISD on smaller through-put GDFs. The Executive Officer and Board staff are directed to complete the assessment within 18 months after the initial certification of an ISD equipped system.*





# ISD Cost-Effectiveness

$$C-E = \frac{\text{annual cost to comply}}{\text{annual emission reductions}}$$

C-E expressed in dollars per pound of  
emission reductions



# 2006 ISD Cost-Effectiveness



- Use actual costs from survey of ISD sites:
  - Equipment
  - Installation
  - Maintenance
- Recalculate emission reductions
  - Based on Healy EVR system alone
  - Emission savings from early detection of vapor recovery system failures based on real world examples



# Veeder-Root TLS-350 Monitors



- ARB cost estimates included cost of new monitor
- Estimate 70-80% of existing sites subject to ISD already have TLS-350 monitors that can be upgraded to add ISD
- New installations are likely to install TLS-350 for both ISD and water board requirements
- Portion of TLS-350 cost attributed to ISD is discussed in survey



# ISD Cost Survey Status

- Mailed to 55 sites on June 28<sup>th</sup>
- Posted on web
- Mailed to additional 49 sites on September 6<sup>th</sup>
- 5 surveys returned so far
- 4 "valid" surveys

# 2006 Example Calculation Equipment Cost for GDF1

GDF1 has two fueling points, one dispenser and "2.5" USTs:

One Pressure sensor:	\$ 900
One A/L sensor:	\$ 900
2.5 Inventory sensors:	\$2863
One TLS-350:	<u>\$6705</u>
<b>TOTAL:</b>	<b>\$11,368</b>

# ISD Equipment Costs per Model GDF

	GDF 1	GDF 2	GDF 3	GDF 4	GDF 5
Number of Dispensers	1	1.5	3	4.5	6
Cost	\$11,400	\$11,800	\$13,200	\$14,500	\$15,900

# Installation Costs

- 2002 EVR Tech Review
- Based on data from ISD pilot site installs
- Assumed labor costs of \$55 per hour

	Base Cost	Additional cost per Dispenser
New	\$250	\$125
Retrofit	\$300	\$200



# Preliminary Data on Returned ISD Cost Surveys

Number of Dispensers	Survey Cost (equip, install, start-up test & permit)	ARB Estimate (equip & install)
2	\$11,000	\$13,000
4	\$12,800 \$19,100	\$15,200
12	\$28,500	\$24,000



# ISD Emission Reductions

- Collect data on VR system operation, maintenance, test results, and inspection history for Healy EVR sites both with and without ISD.
- Estimate ISD emission reductions assuming ISD-detected failures are also occurring at sites without ISD, but for a longer period.

# VR-201-A Spot Check Pressures

District	BAAQMD		SCAQMD		SACTO	
P = UST Pressure (in H2O)	#stations	Ave. P	#stations	Ave. P	#stations	Ave. P
<b>P &gt; 0.5</b>	<b>4</b>	<b>2.38</b>	<b>1</b>	<b>1.2</b>	<b>0</b>	<b>-</b>
<b>0 &lt; P &lt; 0.5</b>	<b>2</b>	<b>0.03</b>	<b>1</b>	<b>0.076</b>	<b>0</b>	<b>-</b>
<b>P &lt; 0</b>	<b>18</b>	<b>-5.92</b>	<b>10</b>	<b>-5.79</b>	<b>3</b>	<b>-7.07</b>
Total # stations	24		12		3	

# Overpressure Problem

IV0700  
JAN 31, 2006 2:01 AM

...

Status Codes: (W)Warn (F)Fail (D)Degradation Fail (G)Gross Fail  
(ISD-W)ISD Self-Test Warning (ISD-F)ISD Self-Test Fail (N)No Test

DATE	ISD	ISD	---CONTAINMENT TESTS---				STAGE			---COLLECTION TESTS-DAILY			
	EVR	%UP	GROSS	DGRD	MAX	MIN	LEAK	I	VAPOR	FP1	FP2	FP3	FP4
01/10	PASS	100%	0.2	0.0N	0.3	-0.4	2			0.97	0.98	0.90	0.98
01/11	PASS	100%	0.2	0.0N	0.8	-4.3	2	PASS		0.98	1.00	0.93	1.02
01/12	PASS	100%	0.2	0.0N	0.3	-3.2	2			0.99	1.02	0.92	1.00
01/13	PASS	100%	0.2	0.0N	0.4	-0.4	3			0.96	1.00	0.92	0.97
01/14	PASS	100%	0.6	0.0N	3.7	-0.9	3	PASS		0.99	0.99	0.93	1.01
01/15	W	100%	3.5W	0.1N	4.1	2.0	1			0.95N	1.01	0.95	0.97N
01/16	PASS	100%	3.8N	3.6N	4.0	2.5	1			0.94	0.99	0.94	0.88
01/17	PASS	100%	3.9N	3.6N	4.2	2.6	1			0.94	0.97	0.95	0.86
01/18	PASS	100%	3.9N	3.6N	4.2	-5.0	0	FAIL		0.92	1.04	0.91	0.93
01/19	PASS	100%	3.9N	3.6N	-0.0	-3.5	0			1.01	1.01	0.97	1.02
01/20	PASS	100%	3.9N	3.6N									
01/21	PASS	100%	3.8N	3.5N				W	100%	3.5W	0.1N	4.1	2.0
01/22	W	100%	3.8W	3.5N				PASS	100%	3.8N	3.6N	4.0	2.5
01/23	W	100%	3.8W	3.5N				PASS	100%	3.9N	3.6N	4.2	2.6
01/24	W	100%	3.7W	3.4N				PASS	100%	3.9N	3.6N	4.2	-5.0
01/25	W	100%	3.6W	3.4N				PASS	100%	3.9N	3.6N	-0.0	-3.5
01/26	W	100%	3.6W	3.4N				PASS	100%	3.9N	3.6N	5.0	-0.2
01/27	PASS	100%	0.3N	0.1N				PASS	100%	3.9N	3.6N	3.9	2.5
01/28	PASS	100%	2.7N	2.3N				W	100%	3.8W	3.5N	4.0	-5.0
01/29	PASS	100%	3.6N	3.1N				W	100%	3.8W	3.5N	0.4	-2.2
01/30	PASS	100%	3.7N	3.3N				W	100%	3.7W	3.4N	1.5	-0.3
								W	100%	3.6W	3.4N	5.0	-0.0
								W	100%	3.6W	3.4N	3.9	-5.0



# Example of Emissions at Site Without ISD

- Air ingested during ORVR fuelings led to UST pressures between 2 and 4 inches water column for 3 days
- Assume 3 inch WC for 36 hrs at max allowable leak rate .....

# Estimated ISD Emission Savings

Fugitive leak rate:  $Q = -0.0018P^2 + 0.0291P + 0.0180$  (from TP-201.2F)

$Q = 0.089$  CFM = 5.3 CFH,  $V = 5.3$  CFH x 72 hr = 385 CF

$385$  CF x 7.48 gal/CF x 8.4 lbs/1000 gal = 24 lbs excess emissions over 3 days

**IF NO ISD SYSTEM,**

**PROBLEM NOT CAUGHT UNTIL NEXT TEST:**

If problem persists for **30 days** → 240 lbs = **0.12 tons**

If problem persists for **60 days** → 480 lbs = **0.24 tons**

If problem persists for **120 days** → 960 lbs = **0.48 tons**

If problem persists for **180 days** → 1440 lbs = **0.72 tons**

If problem persists for **300 days** → 2400 lbs = **1.2 tons**



# C-E Plan Review Schedule



## ■ January 2007

- Draft ISD C-E calculations for CAPCOA review

## ■ February 2007

- Draft ISD C-E Review Report

## ■ March 2007

- Deadline for ISD C-E Report



The background of the slide is a close-up photograph of various autumn leaves. The leaves are in shades of orange, red, and yellow, with some still showing green. They are covered with small, clear water droplets, suggesting a recent rain or dew. The leaves are scattered across the frame, creating a textured and colorful background.

# Questions ?

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